TopologyGAN: Topology Optimization Using Generative Adversarial Networks Based on Physical Fields Over the Initial Domain

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Abstract

In topology optimization using deep learning, the load and boundary conditions represented as vectors or sparse matrices often miss the opportunity to encode a rich view of the design problem, leading to less than ideal generalization results. We propose a new data-driven topology optimization model called TopologyGAN that takes advantage of various physical fields computed on the original, unoptimized material domain, as inputs to the generator of a conditional generative adversarial network (cGAN). Compared to a baseline cGAN, TopologyGAN achieves a nearly 3 × reduction in the mean squared error and a 2.5 × reduction in the mean absolute error on test problems involving previously unseen boundary conditions. Built on several existing network models, we also introduce a hybrid network called U-SE(Squeeze-and-Excitation)-ResNet for the generator that further increases the overall accuracy. We publicly share our full implementation and trained network.